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ABSTRACTS OF PRESENTATIONS

SUBDIVISION AND REGIONAL STRATIGRAPHY OF THE PRE-PUNTA GORDA ROCKS LOWERMOST CRETACEOUS-JURASSIC(?) IN FLORIDA

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In recent years several wells have been drilled in the South Florida Basin through carbonate and evaporite sequences to depths as much as 5300 ft. below the Punta Gorda Anhdrite. The deepest well penetrated igneous basement rocks to a total depth of 18,670 ft. Correlation of anhydrite beds below the Punta Gorda has revealed several thick anhydrite units (200 to 400 ft) with regional persistence.

The pre-Punta Gorda section is subdivided into four easily identifiable units listed in order of increasing age -- Lehigh Acres (lowermost Comanchean), Pumpkin Bay (upper Coahuilan), Bone Island (lower Coahuilan), and Wood River (Jurassic?) Formations, all newly named in this report. In addition, the Lehigh Acres is divided into the West Felda Shale (base), Twelve Geochemical evidence indicates that the Lehigh Acres unit in the upper part of the Pumpkin Bay unit contains the most likely source beds for petroleum.

Only two production tests have been carried out in the basin in strata below the oil-productive Sunniland Limestone. One was through casing in a Wood River dolomite zone. It reportedly produced water and some gas. The other was a drill stem test in an upper Pumpking Bay dolomite zone which produced only water. In the Gulf Florida State Lease 826Y (Permit No. 275), a moderately porous, 350-ft-thick Pumpkin Bay dolomite zone was observed. As this well is west of the axis of the basin, better reservoir conditions presumably exist on the West Florida shelf than onshore.

REFLECTION SEISMIC MEASUREMENTS ON THE WESTERN FLORIDA SHELF

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The U.S. Geological Survey's regional seismic control over the western Florida Continental Shelf consists of 2,800 km of common-depth-point data connecting 14 wildcat wells north of the latitude of Fort Meyers, Florida, 26°30'N. The line layout was designed to tie onshore and offshore wells to the multichannel net of the University of Texas in the deep Gulf Basin.

The regional structure revealed in our profiles consists of a series of basins and ridge arches. In the northwest corner of the shelf, the Apalachicola Embayment, a salt basin, extends onshore to the northwest and is bounded by the Middle Ground Arch on the southeast. Jurassic strata onlap Paleozoic rocks on the Middle Ground Arch, indicating that this feature is a pre Jurassic erosional high. The Tampa Embayment is a structural low south of the Middle Ground Arch. This low is separated from the South Florida Basin by a basement high we refer to as the Sarasota Arch.

The Apalachicola Embayment contains both salt swells and piercement structures. A major facies change is found between this basin, where clayey sands and shales are prevalent, and the Middle Ground Arch, where an increased carbonate-anhydrite content in the section results in higher seismic velocities. Part of the relief of Middle Ground Arch seen in seismic-time sections is a result of this velocity increase.

The Northwesternmost seismic lines reveal the structural evolution of the Destin Dome. Destin is a west-northwest-trending anticline off northwestern Florida. The dome is 80 km long and 30 km wide and has a relief of 1 kilometer on Lower Cretaceous rocks. The dome appears to be a salt swell that formed in Late Cretaceous and Cenozoic time. The deep Exxon test on Destin Dome penetrated 20 m of quartz sand in the Norphlet Formation in which porosity ranged from 20%k to 30% and permeability was 1 Darcy. The existence of this potentially excellent reservoir bed on the west indicates that Destin Dome is still a viable exploration target. Other salt swells are present in the Apalachicola Embayment.

GRAVITY INVESTIGATION OF BASEMENT STRUCTURE NEAR LAKE OKEECHOBEE, SOUTHEAST FLORIDA

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The basement of peninsular Florida is marked by an erosional surface developed along a wide range of rock types. These rocks range in age from Precambrian to Middle Jurassic, and have been termed the "sub-zuni" surface (Applin, 1951). Unknown thicknesses of early Paleozoic and older metasediments underlie some of the Mesozoic volcanic rocks (Barnett, 1975).

A bouguer anomaly map (Oglesby, Ball, and Chaki, 1973) and a map of regional magnetic anomalies (King, 1959) of the State of Florida show many anomalies of similar shape and orientation. Isometric representation of the basement (Wicker and Smith, 1977, 1978) exhibit general anomaly trends that correlate with those of the state Bouguer and magnetic maps. The similarities of these anomalies suggests a structural control, providing the basis for this study.

Long axes of visible magnetic and gravity anomalies trend NE-SW in northern Florida, rotating into an E-W orientation in the middle of the state, and trending NW-SE in the south. In particular, the area of southeast peninsular Florida east of Lake Okeechobee (generally including Palm Beach, Martin, and St. Lucie Counties) exhibits a wide range of anomaly shapes, though most of the long axes of the anomalies trend NW-SE. The most notable anomaly is a very steep gravity gradient through northern Palm Beach county which corresponds to an abrupt south-facing scarp proposed by Wicker and Smith (1977), a large lateral fault proposed y Barnet (1975), and a crustal transition zone proposed by Mericle (1977). This gradient may also be directly related to the thickening-southward post-Jurassic sedimentary section, which ranges in thickness from 1000 meters in the northern part of the state to more than 7000 meters near Florida Bay.

Farther north, in western Martin and St. Lucie Counties, and elliptical gravity and magnetic low also trends NW-SE. The nature of this anomaly has not been resolved.

Other features in this area which are not visible on the Bouguer or magnetic anomaly maps are faults proposed by Miller (1981). One fault trends nearly parallel to the coastline in Martin and St. Lucie Counties, while another (trending NW-SE) exists in northern Palm Beach County.

The objectives of this study are to examine the subparallel anomalies discussed above using both gravity and magtnetic equipment. The three counties will be examined by use of a three mile grid. A detailed Bouguer anomaly map will be constructed with a contour interval of one milligal. The gravity and magnetic data will facilitate the formation of several subsurface geologic models which will be constructed as cross section through prominent anomalies.

GEOLOGY OF MIOCENE TO PLEISTOCENE DEPOSITS IN BROWARD COUNTY, FLORIDA

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As part of a program to define the geologic and hydrologic characteristics of the Pliestocene to Miocene material overlying the Hawthorn Formation in southeast Florida, 27 test wells were drilled in Broward County by a reverse-air dual tube method. Lithologic logs made from the examination of rock cuttings obtained from these wells were used to prepare geologic sections that show the post-Hawthorn sediments to be wedge-shaped from east to west with the thickest part towards the coast.

A distinct and pronounced contrast in lithologies exists between western and eastern Broward County in that the east is composed of beach and shelf deposits, and the west consists of warm, shallow, lower energy deposits. The western part of the county is composed of marine and freshwater limestones of the Fort Thompson Formation and the underlying Tamiami Formation.

The Tamiami Formation consists of two units: an upper gray, shelly limestone unit that, in places, grades into a calcareous sandstone that extends to the coast, and a lower fine-grained, quartz sand unit with increasing clay and silt towards the base. Below the clastic unit of the Tamiami Formation lie silt and clay units of the Hawthorn Formation.

The Tamiami and Hawthorn Formations dip to the east where the Tamiami is overlain by nodular calcareous sandstones and beach sands and the Anastasia Formation. The Anastasia Formation, Key Largo coralline Limestone, and the Miami Oolite. Both the oolitic and bryozoan facies of the Miami Oolite were penetrated in Broward County.

FACIES, SEDIMENTARY STRUCTURES, AND TOPOGRAPHY OF THE LATE PLEISTOCENE MIAMI LIMESTONE

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The use of cores from closely spaced borings in combination with both natural and man made outcrops allows the revision of previous speculations on the depositional history of the Miami Limestone.

The seaward thickening wedge of Miami Limestone is divided into three distinct depositional facies: the bryozoan facies, the bedded facies, and the burrow-mottled facies. The bryozoan facies is restricted to the low lying area west (landward) of the coastal ridge and does not extend eastward beneath the ooid rich bedded and burrow-mottled facies.

The distribution of the bedded and mottled facies on the coastal ridge reflects the morphological division (Halley et al., 1977) of this ooid sand complex into a bankward shoal and channel system, cross-bedding is restricted to the flanks of individual shoals, where it may be vertically continuous throughout the section. The depositional scenario for these shoals of a stabilized interior with a surrounding fringe of active sands is consistent with their present topographic expression.

The seaward barrier bar is a composite of discrete sediment packages which are not laterally correlatable. Each sediment package grades upwward from the cross-bedded facies at the base to the mottled facies at the top, which is marked by a sahrp contact of the upper burrowed surface with the basal cross-bedding of the suceeding unit. Cross-bed dip directions are sometimes east-west perpendicular to the north-south axis of the barrier bar and multidirectional within any one ooutcrop. Large scale trough and channel fill deposits are also common features in the barrier bar.

These observations lead to the following conclusions: 1) contrary to implications of previous studies, the ooid sand shoal complex of the eastern part of the Miami Limestone was built up in place, and did not migrate bankward over earlier platform interior deposits of the bryozoan facies, 2) the distribution of cross-bedding in the shoal and channel system confirms the bar and channel origin for this morphology, and 3) the seaward barrier bar is a more complex feature than suggested by its morphology, probably the result of coalescing tidal deltas.

STRUCTURAL CONTROL OF THE MORPHOLOGY OF SOUTHEAST FLORIDA

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The striking feature of terrestrial and submarine morphology of Southeast Florida is the family of arcuate trends that are convex towards the southeast. From northwest to southeast, these trends are: 1) the southern extension of the Atlantic Coastal Ridge composed of oolitic limestone of the Late Pleistocene Miami Formation; 2) The Upper Florida Keys, a chain of islands composed of the Late Pleistocene Key Largo Limestone; 3) the break in slope of the Florida Reef Track marked by discontinuous living reefs, rocky shoals, and piles of coral rubble; 4) the Pourtales Escarpment of late Tertiary age that marks the edge of the Pourtales Terrace in depths of 360 to 540 meters; and 5) the Mitchell Escarpment in depths of from 720 to 1000 meters that is probably early Tertiary.

Earlier attempts to explain some of these trends emphasized localized accumulation of carbonates over pre-existing relief, but this interpretation fails to explain the occurrence of multiple trends with consistent orientations. Instead, long-lived structural control offers the most reasonable explanation and at least two models deserve consideration: 1) a series of arcuate fault scarps, some of which localized subsequent deposition or erosion; or 2) deposition or erosion along depth contours whose consistent shapes and orientations were determined by regional structure -- the southward-plunging Peninsular Arch.

POST-MIOCENE DEVELOPMENT OF THE SOUTH FLORIDA PLATFORM

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High-resolution seismic data of the southwestern Florida platform suggests that modern shelf is a constructional platform with Late Neogene-Holocene sediments founded on an eroded karstic Miocene platform. This surface gently dips seaward from the coastline with a significant break in

slope in the center of the shelf and at the shelf edge. The slope break on the central shelf coincides with the feature named Pully Ridge, an apparent shoreline remnant.

Over the thickest post-Miocene section and marking the edge of the modern shelf is a double reef complex. The lowermost reef forms a well developed 40 m scarp; the upper reef is characterized for the most of its extent as a low amplitude ridge, but in the central part of the study area, it becomes a well expressed reef-split complex, known as Howell Hook. Within the sediment section, two stratigraphic units are recognized: (1) a lower unit of Pliocene (?) to Pleistocene age which can be traced under the shelf edge reef and continuously onlaps the Miocene (?) surface and (2) a Pleistocene-Holocene unit which is composed of sediment derived from the shelf edge and pelagic sources and exhibits evidence of downslope creep.

A Miocene (?) terrace (-400 to -500 m) trends north-south along the west-facing continental slope of the Florida Shelf. This ridge becomes progressively buried like the younger reefs so that there is no surface expansion of these in the Florida Straits area.

Two sedimentary fans have been identified on the northern slope and floor of the Florida Straits. The apexes of these fans are at gaps in the carbonate ridge that rims the southern Florida shelf. Sedimentary sequences within these fans indicate the presence of at least four complex sigmoidal-oblique sequences. A reef buried by the last sequence correlates with Howell Hook. Radiometric analyses of material dredged from this feature yield an age of 11,000 years B.P. so that the last sequences are most probably Holocene and is some indication of the rate of shelf accretion.

STONY CORAL BANK SEDIMENTS AT 80 m ON THE EASTERN FLORIDA SHELF-BREAK

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Jeff's Reef is a coral bank near the southern end of a discontinuous band of living and dead pinnacles and ridges paralleling the 80 m bathymetric contour. Reef surficial sediment, collected by JOHNSON-SEA-LINK submersibles is gravelly (m = 27). Gravel is mostly coral branches (*Osculina varicosa*) and clams (*Nuculana acuta*); sand is a mixture of lithified carbonate pellets, forams and quartz, surficial sediments, collected by surface vessels, from a 94 km2 flat area surrrounding the reef are sands (n = 56). For weight percent gravel, sand, silt, clay, mud, sorting, skewness and kurtosis, a two-way, ANOVA indicated statistically significant ($p<0.01$) variations west-to-east, and no significant variations south-to-north in shelf sediment. Using these same parameters, some reef sub-environments were statistically identifiable.

On the 16 m high reef, coral colonies break to produce coral stick gravel. Several deployments of a time-lapse camera revealed no fish feeding on/or breaking the coral. Tow-tank tests of coral branches collected alive by JOHNSON-SEA-LINK submersible show that breakage began in currents of 140 cm sec^{-1}.
A year-long record from an averaging-type current meter 1 m off the bottom at the reef base indicated the average maximum current speed was 75 cm sec-1 with peak velocities probably in the range of coral breakage.

Sediment from dead coral pinnacles contain 0.2mm coral sand and coral stick gravel. Tumbling barrel experiments with corals show 0.2 mm sand to be the most abundant abrasion product.

CLAY MINERALS OF THE MIAMI LIMESTONE

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Preliminary x-ray diffraction data on the clay fraction of the Miami limestone has yieded two distinct monomineralic clay suites. The coastal ridge area is characterized by a very crystalline chlorite while the more central parts of the formation contain only montmorillonite in the clay fractions in nearby carbonates, the clays within the Miami formation appear to have undergone diagenetic equilibration. Chemical composition, morphology, and petrographic relationships are being used to investigate the diagenetic processes involved.

SIGNIFICANCE OF FOSSILIZED ROOT-LIKE STRUCTURES IN THE ANASTASIA FORMATION OF PALM BEACH AND MARTIN COUNTIES, FLORIDA

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Fossilized root-like structures are found in the Anastasia Formation at numerous places along the coastlines of Palm Beach and Martin counties. These structures look remarkably like structures found at the "mangrove reef" in Miami, which have been interpreted as fossilized root networks left behind as wave erosion removed a swamp of black mangroves.

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Although a mangrove origin for the root-like structures at the "mangrove reef" seems well established (Hoffmeisfer and Multer, 1965), a similar interpretation for the structures in the Anastasia Formation seems less convincing. The structures in the Anastasia Formation are not found adjacent to present-day mangrove areas, they are located well above sea level, and they occur at places along the shoreline where there are cliffs and vigorous wave attack today.

An important feature of the root-like structures in the Anastasia Formation is that they are found at increasingly higher elevations going northward. Outcrops displaying these structures range from heights of about eight feet above mean low tide level in Boca Raton to more than sixteen feet above mean low tide level at Stuart. If these structures were indeed formed by mangroves, and at approximately the same time, then we must postulate a significant structural upwarping for the Florida peninsula in fairly recent geologic time.

PALEOGEOGRAPHY OF THE SOUTH FLORIDA BASIN

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Cores from deep wells drilled 20+ years ago in South Florida show these sediments were deposited within the photic zone and are not basinal precipitates. Three separate basement structures have been defined which most likely were originally part of Africa. Thick anhydrite sections necessitate barriers that are "reefal" in origin, and the multiple environments of deposition for the marginal clastics indicate it represents a regional nonconformity. Correlations

of the South Florida Basin into the Bahamas and to Cay Sal Bank demonstrate both the timing and the erosional formation of the present day Straits of Florida.

GEOLOGICAL PROCESSES WITHIN THE BIG CYPRESS SWAMP, FLORIDA

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Active geological processes in the Big Cypress Swamp are divided into constructive and destructive carbonate processes. Constructive processes include: 1) precipitation of calcitic mud, 2) cementation and reduction of porosity of the surface limestone and 3) development of calcretes and lithified root casts and mats. Destructive processes include: 1) rock brecciation and 2) chemical dissolution, which together result in karstification (development of deckenkarren), reduction of the surface of the limestone, and accumulation of insoluble residues. Brecciation is further subdivided into: a) mega and microrhizobrecciation, b) bole and windfall brecciation and c) solution brecciation. Peat accumulation, a contemporaneous short-term noncarbonate process, may be included because of its influece in dissolution of carbonates. Chemical dissolution is enhanced by organic acids and processes that increase the surface area of limestone. The destructive processes are responsible for the development of larger scale features such as rock islands, dolines, jointing systems, collapse features, and solution pipes (channel porosity). Smaller scale features produced by chemical dissolution are pock-marked surfaces (rillenkarren) and enlarged fractures (kluftkarren).

Each individual process is associated with a different plant community whose geographic distribution is controlled by specific ecological parameters. The most important ecological parameter is hydroperiod, the number of days per year that the surface is inundated. All processes are either directly or indirectly related to the activity of plants. Periphytic algae in areas of long hydroperiod produce calcitic muds that elevate the surface. On the other hand, forests in areas of short hydroperiod are associated with rhizobrecciation and enhanced limestone dissolution. Organic peats may accumulate in areas of greatest hydroperiod even though rhizobrecciation and minor dissolution may be occuring. Peats commonly produce acidic environments which attack and reduce the surface of adjacent limestones. In contrast this elevates the peat surface causing oxidation of the peats and subsequent lowering of the peat surface. The dominant process in any local area is thus related to a unique plant community and each process operates at a different rate. The result of these simultaneous processes is the maintenance of local relief through time as the entire surface of the platform is reduced. Each local change in relief affects hydroperiod and therefore causes a shift in plant communities or succession.

Early dissolution by the above processes provides dissolved carbonate which is, in part, utilized as cement in the surface limestones. This results in the loss of permeability and a reduction of dissolution of the surface limestone. Once this occurs dissolution becomes more active in the underlying less-cemented limestones which results in either slow subsidence of the upper well-lithified blocks on rapid brecciation aided by plants.

The above processes are believed to have functioned in nearly the same manner as present for the last 5,800 years and possibly for the past 35,000 years. It is likely that they have also developed several times during the Pleistocene whenever sea-level conditions exposed portions of the platform. The absence or reduction of the Pleistocene section and the complex nature of highly irregular contacts and repetitious subaerial laminated crust zones throughout the Pleistocene of South Florida area are explained by analogous processes.

GEOLOGY OF THE SHELL KEY BASIN, FLORIDA BAY

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Shell Key Basin is one of the many local basins ('lakes') defined by anastomosing carbonate mudbanks and mangrove-covered islands in the large triangular-shaped Florida Bay. The basin, approximately 2.5 miles across, is bordered on the southeast by Upper Matecumbe Key and on the other three sides by mudbanks and mangrove-covered islands. Cores through the slightly assymetrical mudbanks reveal a soft micrite with hard layers (= storm layers) and intercalated peat penetrated by roots from the Thalassia grass on the surface. The center of the basin has a thin sediment cover or the Miami Formation is exposed so that the basin section is saucer-shaped. Probing through the soft sediment to the bedrock floor indicates that the same microkarst features are under the Basin as exposed farther north on the mainland. Sonic depth profiles reveal features resembling the Everglade's "rock reefs" on the basement Miami Limestone where exposed.

Sediment accumulating in the basin has a bimodal size distribution which is the result of fine aragonitic needles secreted by algae, especially Halimeda, and abraded bioclastic material. Distribution of the sediment seemingly is affected pronouncedly by periods of intense storms. In general, the salinity and CO_2 of the water decreases as pH and turbidity increase; salinity changes are the result of dilution and circulation; CO_2 changes result from vegetation, light, and temperature; pH is affected by CO_2 production and circulation; and turbidity is due to depth, agitation, and availability of loose material. Geographic position of age dates of the "root-rug" peat in the Bay indicate an anomalous situation where there seems to be a topographic 'high' area roughly parallel to the present Keys.

A NEW HOLOCENE SEA LEVEL CURVE FOR THE UPPER FLORIDA KEYS AND FLORIDA REEF TRACT.

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A new Holocene sea level curve for the upper Florida Keys and Florida reef tract has been constructed by integrating existing and new data from ^{14}C age analyses. New data are derived from 21 mangrove peat samples from three locations and three laminated $CaCO_3$ soilstone crust (caliche) samples from three locations. The new sea level curve is based on ^{14}C ages ranging from 360 ± 60 yrs BP to $14{,}000\pm160$ yrs PB and indicates a fluctuating sea level rise of 0.3 m/yr (14,000 to 7,000 yrs BP, 9.2-7.0 m below MSL, respectively), 1.2 mm/yr (7,000 to 2,000 yrs BP, 7.0-0.75 m below MSL, respectively, and 0.3 mm/yr (2,000 yrs BP to present, 0.75 m below MSL to present MSL).

During the past 14,000 years, no evidence was found in this area for a highstand greater than that of present sea level. The rate of rising sea level, however, has varied. Sea level stand in this area at 14,000 yrs. BP is much shallower than indicated on other published curves for the east coast of the United States.

DEEP SEA DRILLING IN THE WESTERN STRAITS OF FLORIDA

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In January 1981, Glomar Challenger drilled 5 holes in the southeastern Gulf of Mexico to provide ground-truth for extensive seismic surveys and to document the pre-Tertiary history of the Gulf.

Holes 535 and 540 were drilled in a basinal terrane for maximum penetration of the Cretaceous-Tertiary sequence. Rhythmic alternations of light, bioturbated and dark, laminated carbonaceous limestone represent the Early Cretaceous interval. Some of the dark layers are rich but immature oil source rocks. The limestones resemble the Blake-Bahama Formation in the North Atlantic, but their stratigraphic age overlaps in part with the Hatteras Shale. Late Cretaceous rocks are almost totally missing in the basin sites and the Cenozoic section consists of chalk and marly carbonate ooze.

Holes 536, 537 and 538A were drilled on high-standing fault blocks. Hole 537 recovered phyllite that records $^{40}Ar/^{39}Ar$ plateau ages of ca. 500 m.y. and is overlain by an Early Cretaceous deepening sequence of alluvial to littoral clastics and skeletal-oolitic limestones, capped by a thin sequence of Cretaceous and Cenozoic pelagics. In Hole 538A basement consists of mylonitic gneiss and amphibolite, intruded by several generations of diabase dikes (i.e. "transitional" crust). $^{40}Ar/^{39}Ar$ dates of hornblendes and biotite from the regional metamorphic rocks suggest a 500 m.y. ("Pan African") age with a mild late Paleozoic thermal overprint. $^{40}Ar/^{39}Ar$ whole-rock from the dikes suggest intrusions between 190 and 160 m.y. Basements is covered by a thin layer of pelagic chalk, followed by Early Cretaceous skeletal-oolitic limestones and finally Cretaceous-Tertiary pelagics. The skeletal-oolitic limestones at both sites represent either parts of a shallow-water carbonate platform or platform talus deposited in deep water. Hole 536 bottomed in shallow-water dolomite (Jurassic or Permian), overlain by middle Cretaceous skeletal limestones with shallow-water biota and intercalations of pelagic chalk, interpreted as Cretaceous talus at the foot of the Campeche Bank; Cretaceous-Tertiary chalk and carbonate ooze cap the sequence.

Among the most significant results of the leg are the recovery of: (1) "transitional" crust with Early Paleozoic (Pan African) metamorphic rocks, (2) Early Cretaceous deepwater limestones with immature petroleum source beds, (3) mid-Cretaceous platform talus resembling the reservoirs in the Poza Rica and probably some of the Reforma fields of Mexico; and (4) the discovery of a Late Cretaceous hiatus of 30 m.y. that roughly correponds to the "Mid-Cretaceous unconformity" recognized widely on seismic records in the Gulf of Mexico.

THE HAWTHORN GROUP OF PENINSULAR FLORIDA

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The Hawthorn Group in peninsular Florida, a source of controversy since it was first described, has been defined and redefined numerous times. This paper will provide a regional overview of the formation, its occurrence, and lithostratigraphic framework in light of a data base recently enhanced by numerous continuous cores.

The Hawthorn Group occurs primarily in the subsurface and is present over much of the peninsula. It is absent only in the vicinity of the Ocala Uplift, the Sanford High, and the Kissimmee Faulted Flexure where it has been removed by erosion. In northern peninsular

Florida the Hawthorn dips and generally thickens to the east and northeast with a maximu thickness of nearly 500 feet occurring in the Jacksonville Basin. In sourthern peninsular Florida it dips and thickens to the southeast, south, and southwest obtaining a maximum thickness in excess of 800 feet.

Lithologically the Hawthorn Group is quite heterogeneous and includes sands, clays, dolomites, and limestones. Phosphate is virtually ubiquitous throughout the unit ranging in amounts of less than 1 percent to greater than 50 percent. Specific lithologic criteria used to identify the upper contact of the Hawthorn vary regionally. The upper boundary is generally equated with sediments containing varying proportions of quartz sand and silt, phosphate, carbonate (dolomite, dolosilt, and limestone), and clay. The upper Hawthorn is generally greenish in color due to the clay minerals present. A unit of reworked Hawthorn sediments is often present at the top of the formation and is included within it. The base of the Hawthorn is generally a sandy, phosphatic dolomite, however, it varies locally.

The vertical sequence of sediments that comprise the Hawthorn Formation also vary regionally. In northern Florida the section often consists of four parts: an upper reworked unit, a mixed carbonate-clastic unit, a predominantly clastic unit, and a lower predominantly carbonate unit. In southern Florida the sequence consists of an upper predominantly clastic unit and a lower predominantly carbonate unit. Phosphatic rubbles and brecciated carbonates frequently occur throughout the section in both areas.

The upper and lower boundaries of the Hawthorn Group are most distinct in northern Florida and least distinct to the south. In northern Florida the Hawthorn is overlain by sands and shell beds and underlain by the Suwannee Limestone and Ocala Group limestones that provide definitive boundaries. In south Florida however, problems with defining the units above and below create difficulties in the placement of the formation contacts. The authors have included the lower clastic section (quartz and dolomite silts, quartz, sands, clays, and phosphate) of the Tamiami Formation and phosphatic sandy limestone formerly assigned to the Tampa Formation in much of southern Florida in the Hawthorn Formation.

NON-OOLITIC, HIGH-ENERGY CARBONATE SAND ACCUMULATION: THE QUICKSANDS, SOUTHWEST FLORIDA KEYS

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Approximately 162 km of high resolution subbottom seismic reflection profiles, collected in the Quicksands area west of the Marquesas Keys off south Florida indicate extensive westward transport of *Halimeda* sand. The carbonate sand accumulation is oriented east-west, is up to 12 m thick, and encompasses an area 13 km by by 29 km. The Quicksands area is ornamented by east-west trending submarines and dunes 2-3 m high shaped by strong reversing north-south tidal currents. Many dunes break the surface at low tide. Submarine dunes rest directly on Pleistocene bedrock at the eastern end of the study area, but at the western end, dunes rest on 7-10 m of Holocene carbonate sand. Near the western terminus, the sands have accreted over and are underlain by carbonate muds.

Westward drift, probably caused by prevailing east and southeast winds superimposed on the tidal currents, is indicated by (1) thickening of the Holocene accumulation to the west and (2) by large-scale, westward-dipping accretionary bedding. Seismic reflection profiles show spit-like

accretionary bedding in a package up to 1 km long at the western end, where carbonate sands spill onto deeper-water muddy carbonates.

The submarine sand body is surrounded on the south, west, and north by equivalent age, topographically lower lime muds and silts up to 7 m thick. The configuration and patten of deposition suggest that this area could be used as a petroleum exploration model. The model consists basically of a reservoir-size porous carbonate sand ridge surrounded downdip by organic-rich carbonate muds, which could serve as source beds. Reserving tidal currents and bed forms are identical to those of oolitic areas in the Bahamas; the Quicksands area, however, does not contain ooids.

EPISODIC BARRIER ISLAND GROWTH IN SOUTHWEST FLORIDA: A RESPONSE TO HOLOCENE SEA-LEVEL FLUCTUATIONS?

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The Lee County, Florida, barrier islands are composed of beach ridges organized into distinct sets that are separated from each other by erosion surfaces. Beach ridge patterns suggest both littoral and direct on-shore sand transport. These beach ridge sets are further differentiated on the basis of average elevation into "low" and "high" plains. The "low" plains are about one meter and the "high" plains about two meters above local mean sea level. Topographically distinct and geographically adjacent beach ridge sets having similar ^{14}C-determined depositional ages record a major sea-level fluctuation. The date of this fluctuation is within the 200 to 400 year error margin associated with the radiocarbon technique. Four major Holocene sea-level fluctuations have been identified in these islands: 1) a rise at about 2000 ^{14}C-years B.P., 2) a fall at about 1500 ^{14}C-years B.P., 3) a rise about 1000 ^{14}C-years B.P., and 4) a fall about 500 ^{14}C-years B.P. Each of these sea-level positions resulted in barrier island growth or creation. Sediments were supplied from the near-shore region and by barrier island erosion. Each sea-level fluctuation was composed of an initial depositional phase followed by an erosional phase, as the more important near-shore source was depleted. This depletion may have been caused by the near-shore sources achieving an equilibrium profile. In this region barrier islands have grown by shoal emergence. The oldest such preserved event occurred approximately 3000 ^{14}C years B.P. 268 ^{14}C determinations were made on individual mollusk shells collected at 27 localities throughout the Lee County, Florida, barrier islands.

PALEOENVIRONMENTAL AND PALEOECOLOGIC IMPLICATIONS OF RECENT FORAMINIFERAN DISTRIBUTIONAL PATTERNS IN THE LOWER FLORIDA KEYS

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Foraminifera are important both as biotic elements of communities and as skeletal constituents of sediments in the marine waters of south Florida. A better understanding of the distributional patterns, habitats, and ecology of benthic foraminifera, as well as relationships between biocoenoses and thanatocoenoses, can lead to more accurate paleoenvironmental interpretations.

Phytal samples and associated bottom sediments containig foraminifera were collected from lagoonal, tidal channel, inner shelf, and outer reef environments in the vicinity of Big Pine Key. Most individuals on the plants were alive and most individuals among the sediments were dead when collected. Sanders' similarity index indicates that the biocoenoses on different kinds of plants within the same environment are similar and that the biocoeneses from different environments are dissimilar. The Shannon-Wiener information function shows a correlation between diversity and evenness of living species as related to environmental variability.

Additionally, biocoenoses from vegetation generally are dissimilar to thanatocoenoses among sediments from the same area, although the degree of similarity increases in more restricted environments. Postmortem processes, such as size sorting and differential destruction of tests, affect the general character of species diversity and evenness indigenous to living assemblages. Therefore, the thanatocoenosis preserved among the sediments may not be an accurate reflection of the nature of the living assemblage, thus hindering paleoenvironmental reconstruction based on degree of sorting, species diversity, suborder percentages, characteristic species, and diagnostic associations.

KEY BISCAYNE'S "MANGROVE REEF", A REFLECTION OF BARRIER ISLAND AND SEA LEVEL HISTORY

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The "mangrove reef", a rocky intertidal platform at the north end of Key Biscayne, was shown by Hoffmeister and Multer to be composed of calcified black mangrove roots of late Holocene age. Similar exposures are occasionally exposed elsewhere along eroding portions of Key Biscayne and Virginia Key. The significance of these features can only be determined by understanding the stratigraphic and sea level history of the area.

The calcified black mangrove roots occur in well sorted, calcareous quartz sands that commonly contain low angle, seaward dipping layering-beach sand. The mangrove reef is intimately associated with the older beach ridges of Key Biscayne. Restricted lagoonal muds and red mangrove peats bayward of the mangrove reef yield carbon-14 dates suggesting that these beach ridges formed 3,500 to 4,000 years BP (with sea level some 1.5 to 2 m below present level). With continued sea level rise, mangroves eventually colonized the lower flanks of the ridges. Present elevation of the calcified roots in the mangrove reef suggest that this occurred 3,000 to 2,500 years ago, but timing is dependent on specific local topography.

Though Bear Cut, separating Virginia Key and Key Biscayne, has been open since at least 1520, the lagoonal mud and red mangrove peat sequence to the west of the mangrove reef attest to a seaward barrier that must have been present between at least 3,500 years BP.

The 5,600 year BP dates found for the calcareous (beach) sands of the mangrove reef cannot be used as a guide to sea level history (as was attempted by Fairbridge). Modern beach sands from Key Biscayne give similar dates.

GENERALIZED STRATIGRAPHY AND GEOLOGIC HISTORY OF THE SOUTH FLORIDA BASIN

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The Post-Eocene is composed of some 1200 (360 meters) feet of mixed clastics and carbonates. The Eocene is a chalky limestone of some 2500 feet (750 meters), containing occasional dolomite beds. The 2700 feet (810 meters) of Paleocene is anhydrite and dolomite with minor limestones. The Upper Cretaceous is mainly a chalkly limestone some 2400 feet (720 meters) thick. The Paleocene-Gulfian Cretaceous Rebecca Shoal Dolomite (2500 feet) and the Gulfian Card Sound Dolomite (1400 feet) are both reefs. The lower Cretaceous is some 7000 feet (2100 meters) thick and is divided into the very cyclic carbonate-evaporite Comanchean and the less cyclic limestone and anhydrite Coahuilan. The dolomite-anhydrite Wood River Formation is mostly Jurassic in age.

Three different sets of basin configuration characterize the Jurassic-Coahuilan, Comanchean and Cenozoic time intervals.